Maple Syrup Digest

VOL. 19A, NO. 3 OCTOBER 2007

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MAPLE SYRUP DIGEST

Official publication of the

North American Maple Syrup Council www.northamericanmaple.org

Published and Edited by:

ROY S. HUTCHINSON • P.O. BOX 240, CANTERBURY, NH 03224

Phone: 603-783-4468 • Fax: 603-783-9953 • Email: mapledigest@tds.net

Published four times a year (Feb., June, Oct., Dec.)

NORTH AMERICAN MAPLE SYRUP COUNCIL DIRECTORY OF OFFICERS

DIGEST ADVERTISING RATES

Full Page	240.00
1/2 Page Vert. or Horz.	135.00
Column Inch	19.00
Classified	70c per word

COPY DEADLINE: First of the month preceding date of issue

SUBSCRIPTION RATES

United States	1 year - $6.00
Canada, **US funds**	1 year - $8.00

COVER: Snavely's Sugar House, Republic, Ohio.

GREETINGS FROM YOUR PRESIDENT

It happens about this time every year – what happened to the summer? The plans for sugarhouse repairs, work in the sugarbush and pipeline system expansion suddenly seem urgent as cooler weather approaches the maple region. In a short time we will be in Ohio for the annual joint meeting of the North American Maple Syrup Council and the International Maple Syrup Institute. Our friends in Ohio have been working hard in order to make these meetings a success, and there will be much to learn and share.

For many years our industry has been concerned with a surplus of pure maple syrup. Increased marketing and educational efforts by producers, maple associations and government organizations have resulted in a greater world-wide demand for our product. Combined with one of the poorest crops in decades, we now find ourselves in a different position. Demand is up, supply is down. The huge surplus is quickly being diminished, and now we need to take a careful look at the poor crop results from this past spring. Was it an anomaly or is this what we can expect in the future? Can we as producers afford to continue producing maple syrup if the crop production levels cannot be stable or increased?

The answer to these questions lies in maple research. Over the years, our research institutions have provided us with information that has lead to increased production, higher quality products and better efficiency. With the possibility of unusual spring-time weather patterns looming on the horizon, right now our maple research is even more important. Good research resulting in good data requires a lot of time, hard work, and expense. The NAMSC Research Fund has hobbled along for years with minimal funding. Each year needed research costs more, but yet we have not significantly increased our financial resources or funding levels. In order to have the necessary research data for the future, we must increase our level of funding for these research projects. At present levels, our Research Fund can barely fund but a few significant projects. We really need ten times the financial resources to address the research requirements in the future.

It's time for our industry to step up to the plate and examine how we can better support our maple research institutions. The future and viability of the maple industry depends on it. The "penny-per-container" voluntary contribution has been a big help in the past, but we need better support. We need support from more than just one container manufacturer and many individuals. This support should come from a broader base of equipment and container manufacturers, producer associations and individual producers. Remember: this is our future we are investing in.

The NAMSC annual meeting this fall will provide a forum for ideas on how to make this happen. Is it time to make a better effort for support from all container manufacturers instead of just one or two? Is it time for a voluntary two-cents per container contribution? How can your producer association help? Please attend these meetings in Ohio in October and help us plan for the viability and success of our sweet business.

Sincerely,

Tom McCrumm

IMSI NEWS

By Larry Myott
Executive Secretary

SUMNER DOLE RETIRING AT NEW HAMPSHIRE

New Hampshire Extension Forester Sumner Dole, long a fixture at our international meetings, is retiring in early October. He reported that after 32 years, it is time. He has lots of work to do in his own woods and plans some traveling with family. He intends to keep active in the maple world, too.

Dole is a director of the IMSI and one of the founders of the IMSI sponsored International Maple Grading School. His work with the University of New Hampshire Extension Service has been well known for many years. His current email address is sumner.dole@unh.edu.

FAIR SEASON BRINGS SUCCESSFUL PROMOTIONS

Now that most of the agricultural fairs are past, we can sit back and evaluate the successes of our various state or provincial efforts to promote maple syrup. Many of the state or local maple organizations have sugar houses on the fair grounds and not only promote, but market maple products. These promotions often provide lots of funding for research projects that have greatly helped the industry over the years.

There are some associations that are very well established in the fair business. The Chittenden County Maple Producers Association in Vermont was founded in 1976. This was two years after their founding group had built a sugarhouse at the Champlain Valley Fair in Essex Jct. Today that sugarhouse is one of the big attractions at the fair and a center piece for fair goers, "Meet you at the sugar house."

That producing group and more than 200 volunteers staff the facility for ten days of actual fair and several days of setup and cleanup. Their 2007 gross was more than $110,000 (as of this writing the final numbers weren't available) after ten days of great weather and huge crowds.

Visitors at the Chittenden County Sugarhouse included sugar makers from around New England, New York and Quebec. Every sugarmaker at the fair must see the biggest maple promotion at any fair.

Some of the visitors at this fair were New York Sugarmakers who are in the process of developing their own sugar house at the New York State Fair in Syracuse. I look forward to being a guest at that new facility during the 2008 New York State Fair.

GRADE STANDARDIZATION WORK CONTINUES

At the last meeting of the IMSI Board, the Grade Standardization Committee gained authorization to continue their work to develop new maple syrup grade descriptors that will be universally used to describe the grades by flavors. The Board voted up to an additional $15,000 expenditure for quantitative research on the project.

This committee has been working, under the leadership of Ontario's

Dave Chapeskie, for several years to develop a method of "harmonizing grade descriptors." More information will be presented to the membership at the Ohio annual meeting in October.

For information on the IMSI, call or write Larry Myott, IMSI Executive Secretary, 5014 Route Seven, Ferrisburgh, VT 05456. Email: Larry.Myott@uvm.edu, visit the IMSI at: www.internationalmaplesyrupinstitute.com

INTERNATIONAL MAPLE GRADING SCHOOL

The 4th IMSI International Maple Grading School will be held in Wooster, Ohio, on October 25 and 26, 2007, immediately following the joint North American Maple Syrup Council and the International Maple Syrup Institute conference being held in Akron, Ohio on October 21-24. This popular school is an officially sanctioned program of the International Maple Syrup Institute. This school was developed for maple producers, bulk syrup buyers, state inspectors and others needing to accurately grade maple syrup or to judge maple product entries at fairs and contests. Pertinent quality control issues are also covered. The school is conducted by the University of Maine Cooperative Extension, University of New Hampshire Cooperative Extension and the Vermont Agency of Agriculture, Food and Markets. Ohio State University Extension is the host this year, the first time the maple grading school is being held outside of New England. Space is limited and pre-registration is required. For further information Sumner Dole, Phone at (603) 527-5475, Fax (603) 527-5477 or Email sumner.dole@unh.edu.

International Maple Syrup Institute OSU Extension embraces human diversity and is committed to ensuring that all educational programs conducted by Ohio State University Extension are available to clientele on a nondiscriminatory basis without regard to race, color, age, gender identity or expression, disability, religion, sexual orientation, national origin, or veteran status.

13th Annual New York State Maple Producers Winter Conference

January 4th & 5th, 2008

A grower-focused 2008 NYS Maple Conference will provide practical and hands-on information for maple producers to build into existing and expanding operations.

Plan now to attend the 2008 New York State Maple Producers Winter Conference. Schedule these dates in your planner or in your computer or maybe even in your head but be sure you set aside January 4th and 5th to get together with lots of other maple producers. The 2008 Maple Conference will be held in the same great location, the Vernon-Verona-Sherrill High School in Verona, New York on Friday evening January 4th and all day Saturday, January 5th. This central location provides plenty of meeting space as well as room for a large trade show with over 25 exhibitors displaying plenty of specialized equipment for meeting maple producer needs. This year we are introducing a slightly more relaxed session schedule that will include the latest in research and grower experiences regarding maple production, promotion, forest management and the making and marketing of a variety of maple products. This day-and-a-half event has something for every level of maple producer. A maple conference you will not want to miss.

The conference kicks off Friday evening with a featured speaker at 7:00 PM and industry trade show highlighting maple equipment, manufacturers, and vendors scheduled from 6:00 PM until 9:00 PM. More than 25 exhibitors are anticipated to display a complete line of maple equipment including evaporators, vacuum pumps, tubing supplies, and value-added processing equipment and supplies.

Saturday's program features 40 of the industry's leading maple experts from throughout North America and Canada presenting in a variety of concurrent workshops. These workshops focus on several major areas of emphasis: beginning sugarmakers, new and advanced technologies, marketing, promotion, value-added products, maple tapping, tubing, vacuum, and forest management.

The conference is open to the general public, as well as maple producers, and is geared to all levels of sugar makers. Saturday's trade show opens at 8:00 AM with workshops starting at 9:00AM. Held at the Vernon-Verona-Sherrill (V.V.S.) High School, Verona, New York, the conference is sponsored by the V.V.S. FFA, New York State Maple Producers Association and Cornell Cooperative Extension. The V.V.S. High School is located between Utica and Syracuse, New York on State Route 31 just two minutes from NYS Thruway Exit 33. Overnight accommodations are within five minutes of the conference site. For additional information contact V.V.S. FFA advisor Keith Schiebel at <kschiebel@vvsschools.org>, or visit the school's website at: www.vvscentralschools.org. Registration information and forms will also be available at the New York State Maple Producers Website: www.nysmaple.com or the Cornell Maple Program website: cornellmaple.com in November and

LECANIUM SCALE: WHAT A STICKY MESS!

Emma Rogers, Margaret Skinner and Bruce L. Parker
Entomology Research Laboratory, The University of Vermont
661 Spear Street, Burlington, Vermont

If you have a sugarbush in the Northeast, you may have noticed brown scale insects, sticky dripping honeydew, and black sooty mold on your sugar maple leaves in 2005 and 2006. That most likely was European fruit lecanium scale, Parthenolecanium corni (Bouche). This insect was introduced from Europe many years ago and is now found throughout much of the US and Canada (Johnson & Lyon 1988). It is in the same insect group as aphids and mealybugs, and feeds on the sap of a variety of forest, shade, and ornamental trees, including most importantly to us, sugar maple. Severe lecanium scale infestations can cause defoliation, twig dieback, and premature leaf drop. These effects were seen in numerous maple stands in Vermont during the past few years, and in 2005 their negative effects on sugar maple tree health became particularly severe. In 2005, in response to concerns of sugarmakers, researchers at the Univ. of Vermont's Entomology Research Laboratory began to investigate the problem. A search through the scientific literature netted minimal information on the biology and management of lecanium scale. Considering the significant impact this insect was having in maple trees in Vermont, we felt it was critical to find answers to several key questions:

- What is the life cycle of lecanium scale in the Northeast?
- What is the best way to sample for lecanium scale?
- How is the scale distributed on a tree (lower, middle, or upper branches)?
- How is the scale distributed in a stand?
- What natural enemies occur in sugarbushes?
- What is the population trend for lecanium scale?

The first phase of our research was to gain an understanding of the life cycle of lecanium scale in Vermont. We needed to know when egg laying and hatch occurred and when the immatures moved to the leaves. We also wanted to know when the crawlers (immatures) returned to the twigs to settle down for the winter. The research was conducted at the sugarbush of Mr. R. Vallee, in northwestern Vermont. Observations and collections were made weekly from June 2005 through October 2006 leading us to develop a projected life cycle of lecanium scale for this region (Fig. 1)

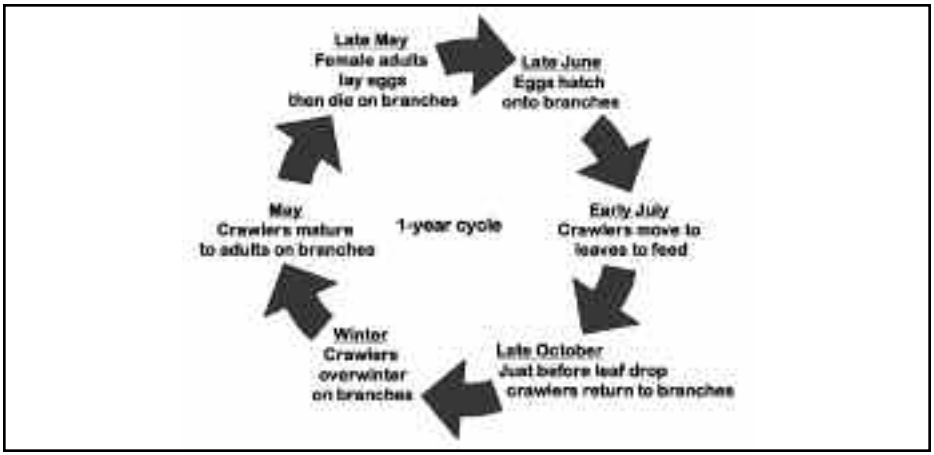

Figure 1. Proposed life cycle of European fruit lecanium scale in Vermont, based on field studies conducted in 2005 and 2006.

Females lay around 1,000 eggs under their hard shell in late spring (Johnson and Lyon 1988). Crawlers, when they first hatch, are about the size of a sesame seed (less than 1/16th in.), transparent or white in color, and very flat and softbodied. They can be seen moving about on the twigs. They soon crawl onto the foliage where they insert their stylet to feed on sap on the undersides of leaves (Fig. 2). They grow only slightly larger over the summer. In 2005, there were many crawlers, which almost completely covered the lower surface of most infested leaves. Some crawlers die during this phase. The dead ones are shriveled up, yellow or brown, and even flatter than healthy crawlers. When the crawlers move back to the twigs in the fall to overwinter they are slightly larger (about 1/16th in.) and reddish-brown.

In the spring, crawlers secrete a hard coating or shell which provides protection. This shell continues to grow larger until May when the crawlers develop into immobile adults under the characteristic dome-shaped reddish-brown scale

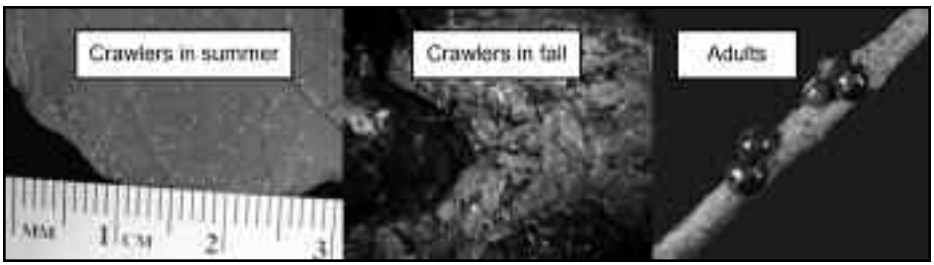

Figure 2. Life stages of the European fruit lecanium scale. Scale crawlers are tiny flat yellowish dots on the undersides of leaves in the summer. Crawlers move back to the twig in the fall, appearing as an oval reddish-orange soft-bodied insect. Adults produce a hardened reddish-brown dome-like shell under which it overwinters and lays its eggs (Photos by R. Kelley).

(up to 3/16 in. diameter). At this stage the scales are still actively feeding and secreting sticky honeydew that attracts ants. Black sooty mold often grows on the honeydew too. These adults that you commonly see are females--males aren't needed for reproduction. Little was known about male lecanium scale until this spring when an observant Canadian naturalist, Rob E. Lee, noticed large numbers of males on Leatherwood and Ironwood trees, though in Vermont they have not been observed (Lee 2007). Mr. Lee began to differentiate males from females in mid-May when as many as 70% of the immature scales he was following developed a pair of white, thread-like tails and, upon lifting their protective shells, he discovered winged insects unlike the stationary females described above (Fig. 3). The immature male scales have a whitish, translucent elongate covering, and the adults have a brownish head and thorax and one pair of whitish wings (Fig. 3). These males were not observed on sugar maples in the same area. The life cycle we observed in Vermont is likely to be similar to that of European fruit lecanium scale found in stands in other areas of the country, but the exact dates may vary depending on the specific climate and other environmental factors in those areas.

In sugarbushes with heavy scale infestations, sugar maple tree health appeared to be significantly affected. Many of the infested trees showed signs of twig dieback and general decline. In 2005, complete mortality of small sugar maple seedlings and almost complete dieback of larger seedlings and saplings in the understory were reported for some sugarbushes (Decker et al. 2007). In some stands we visited in 2005, it was unclear, however, if the symp-

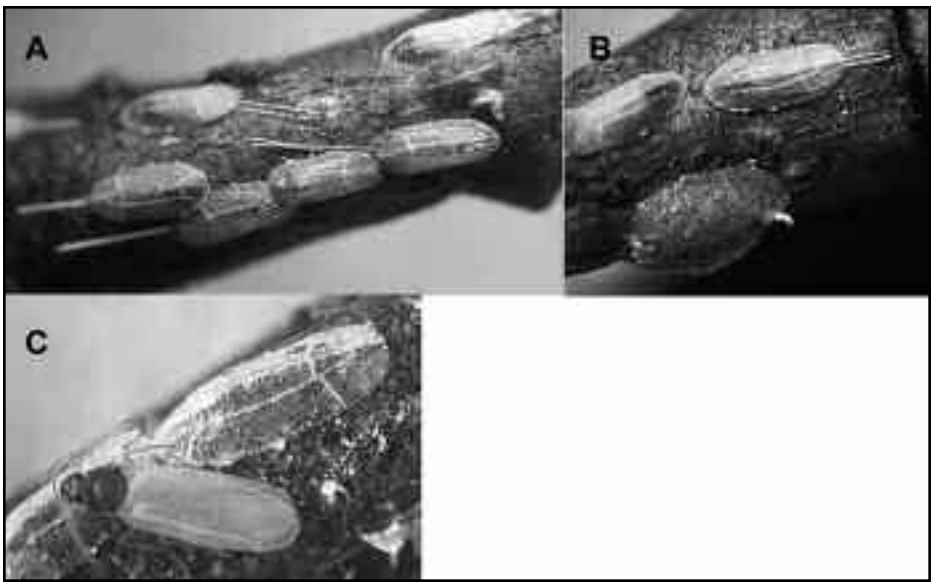

Figure 3. Male European fruit lecanium scale; A. immature male scales; B. two immature male scales (top) beside one female scale; C. Adult male that emerged from the scale (Photos by R. Lee).

toms of decline we observed were the result of feeding by the scale alone or early spring feeding by pear thrips, Taeniothrips inconsequens, which continues to cause intermittent damage from year to year.

In future articles, we will report on data generated on the distribution of European lecanium scale within a tree, and the natural enemies of this insect pest. These biological control agents appear to have a significant impact on scale in some years. Some sugarmakers in our region have noted that scale populations have declined in their sugarbushes, but the problem is not over, as scale populations remain high in other Vermont stands. It is unknown what factors triggered the outbreak we observed in 2005, nor what the impact might have been to the health of the maples. However, this unforeseen scale population explosion couldn't have come at a worse time. Many of the affected maples in 2005 had been struck by pear thrips in the early spring, followed by the attack of both scale and forest tent caterpillar later in the season. Even the healthiest maple has a hard time defending itself from these many assaults.

ACKNOWLEDGMENTS

The authors thank the North American Maple Syrup Council Research Fund for supporting this work, Mr. Vallee for his enthusiastic interest in the project, and Rob Lee, Ontario, CA and R. Kelley, VT Dept. of Forests, Parks & Recreation for photos included in this article. Funding was also provided by two University of Vermont undergraduate student programs: Hughes

Endeavor for Life Science Excellence (HELiX/EPSCoR) award and the Undergraduate Research Endeavors Competitive Award (URECA).

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SLEEP IN A SILO, DINE IN A MILL, SHOP IN A FACTORY —

. . . One last chance to sign up for the 2007 NAMSC/IMSI International meeting in Akron, Ohio. The conference will be held at the Crowne Plaza Quaker Square — one of the most unique and exciting hotels in the world!

The conference dates are October 21st thru the 24th. For room reservations call (330) 253-5970, or www.quakersquareakron.com.

For more information on the conference itself, contact Dick Schorr at: maplemeister@fuse.net or go the the Ohio Maple Producers website at: www.ohiomapleproducers.com

North American Maple Syrup Council, Inc.
RESEARCH FUND

MAPLE RESEARCH
needs more financial support!

The below average production of syrup this past season was a wake up call for us to increase our understanding of how we can maximize our production and preserve the future of the sugar maple and the maple industry. It was also a wake up call regarding the dollar size of the Research Fund for grant distribution and the Fund's dependence on the "penny per container" program. Fewer containers equals fewer pennies.

This formula doesn't work.

In the face of identifying MORE worthy areas of research, we have LOWER contributions from containers this year.

The Research Fund is solely dependent on contributions. Thank you to those who already contribute. To those who have not, ***we'd like to hear from you with contributions AND those areas you would like to see researched. Finding the answers to the questions that are important to you requires your support!***

For more information regarding the Research Fund contact:

Eric Randall, Chairman, 107 Granada Dr., Edinboro, PA 16412
E-mail: erandall@edinboro.edu
Kay Carroll, Treasurer, 79 East Chestnut Hill Road, Litchfield, CT 06759
Phone 860-567-3890, Email: kaycarroll@aol.com
The NAMSC-Research Fund is a non-profit, volunteer managed committee of the North American Maple Syrup Council, Inc. (10-07)

FROM THE EDITOR

On August 26, 2007 Phil Collins passed away unexpectedly. Our sympathies go out to his daughter, Beth Collins, long-time delegate and past president of the North American Maple Syrup Council.

The family has asked that Memorials be given to the Boy or Girl Scouts, KAXE Radio in Grand Rapids, MN, or the local chapter of American Field Service (AFS). Beth Collins can be reached at beth.collins@mn.usda.gov.

The members of this organization are getting older and more are passing on. We need more young people to join and take over some of the responsibilities of this organization. This is true of our own state organization and I suspect most others.

We have had a decent summer with a fair amount of rain, we had a good yield from our gardens and the maple trees appear to be in good health. However, as I sit in the office and look across the field, I see maples starting to change color. Is this stress related or an early foilage season? Who knows.

Looking forward to the conference in Ohio and a nice long fall. As always we urge our readers to patronize our advertisers, we have said it over and over again, but truly, the Digest could not be produced if not for our advertisers.

Roy

REPORT FROM RUSS DAVENPORT

This report is from Russ Davenport on a very tedious time in my life. On May second I entered Baystate Franklin County Public Hospital to have the infected hip prosthesis removed. The staph infection was the result of an injury to my mouth that caused extensive bleeding. After two weeks in the hospital and a month in a rehab facility I am homebound with leg traction about half the time. I get around with a walker to get meals and do my daily chores.

To complicate this whole matter during my second week in the hospital Martha's and my home burned to the ground. We have survived with the extremely generous help of friends and neighbors. We now live in a temporary housing trailer equipped for handicap living. The loss of the home seems bearable with the help of our farm family and friends. My doctor says it will be at least two months before a hip prosthesis will be considered.

Besides all the daily living things that were lost some were historical material of the North American Maple Syrup Council. The series of the "Maple Syrup Digest's" back to 1962 and copies of all the manuals, research and meeting programs and reports are now ashes. I'm sure other NAMSC members have libraries of the memorabilia. The early big format, "Maple Digests" are what I miss the most as well as copies of the government research proceedings from Philadelphia Laboratory. If anyone has spare copies I would like to obtain such.

In the meantime farm work goes on as does the building of a new hay storage pole barn 72' x 60' and high enough to stack four round bales. Only about one-third was done on first cutting. Soooo, cheer up, things could get worse or better. Incidentally a new home will go up before winter our son says.

My work at Sugarhill still goes on. I do wish to congratulate Luc Lussier and David Marvin on their induction into the American Maple Hall of Fame. Not being able to attend the ceremony personally, my gratitude goes to the other members of this great maple family who carried out the proceedings, especially Gordon Gowen of New Hampshire and Dick Haas of Sugarhill. Thank you all for your kindness.

Sincerely,
Russ Davenport

TEMPERATURE PATTERNS WITHIN AN OIL-FIRED MAPLE EVAPORATOR

Mark Isselhardt, Abby van den Berg and Timothy Perkins
University of Vermont Proctor Maple Research Center

INTRODUCTION

Knowing the temperature in the evaporator is an essential part to making quality pure maple syrup. The temperature of the liquid near the draw off is of particular interest to the sugarmaker. When a simple evaporator is operating, sap (~ 2% sugar) enters the back of the evaporator and boiling hot syrup (~ 66 % sugar) exits the front. In between these points, temperature and density gradients develop. That is to say, the sugar in the sap becomes more concentrated the closer it is to the draw off. A day of boiling is marked by the periodic drawing off of syrup. If the system is running smoothly, the time interval for draw offs tends to be fairly regular. This article will describe how temperature varied within an evaporator during the 2006 season. This article will discuss observations of temperature in each partition and how the front and back pans temperatures are influenced by the draw off events.

MATERIALS AND METHODS

A new CDL-Dallaire 3'x 10' oil-fired, raised flue, cross-flow evaporator was used for the 2006 sugaring season.

The evaporator was installed in the University of Vermont, Proctor Maple Research Center's Maple Production Research Facility in Underhill Center, Vermont. The facility sits at approximately 1400' in elevation. The evaporator was equipped with steam hoods over both the front and back pans. The burner was rated for approximately 10.4 gallons of fuel consumption per hour and had been tuned prior to the season for optimal draft and combustion. Sap for the experiment was produced at the Proctor Maple Research Center. The sap was filtered and pumped into a 1,200 gal stainless, welded storage tank which fed the evaporator during boiling. Sap entering the evaporator was not concentrated using reverse osmosis or pre-heated and had a seasonal average brix of 1.9°. The air temperature in the building did fluctuate depending on ambient weather each day and how long the evaporator had been in operation.

A divider separates the back pan into two compartments. A small opening in the divider allows sap to move between the two compartments. The partition connected to the raw sap source will be referred to as Partition 1. Sap flowed into Partition 1 through a pipe which terminated close to the rear-most front pan. Partition 2 will describe the other half of the back pan. Sap flowed from Partition 1 to 2 via a small opening in the rear of the back pan. The front pan is made up of two 18" x 36" cross-flow style pans connected in series. Each of the two pans is further divided into two compartments, resulting in a total of four partitions in the front of the evaporator. These partitions were sequentially numbered, with Partition 3 being closest to the back pan and Partition 6 is the last partition of

the front pan, also referred to as the draw-off partition. Sap is supplied to the Partition 1 from the sap storage tank via glass milk-tubing. The flow of incoming sap is regulated by a mechanical float box. Because the entire volume of sap in a raised flue evaporator's back pan is above the arch rails, a depth control mechanism is necessary between back pan and front pan. The mechanism is similar to the float box for sap entering the back pan. The float box allows the depth in both pans to be controlled independently. The depth of sap in the back pan of a raised flue evaporator must be sufficient to cover the top of the raised flues. The evaporator was operated using a depth of 9" in the back pan (1" above the top of the flues) and 1.5" (from the pan bottom) in the front pan.

Partition 6 in the front pan was equipped with a CDL "Thermo" automatic draw off. This device includes a valve, a digital display and a temperature probe. The valve is made up of a weighted metal plug and a solenoid. When the temperature being measured at the probe matches a preset temperature on the display the solenoid is energized and opens, lifting the weighted plug, allowing liquid to flow out until the temperature at the probe falls below the preset temperature. This device is designed to simulate a sugarmaker watching a thermometer placed near the draw off and regulating the flow of syrup out of the evaporator.

Temperature measurements were made using thermocouples imbedded in ¼" stainless steel tubing and connected to a recording thermocouple scanner (Digi-

Sense model 92801-10). Recording began with the initial firing of the evaporator and continued until the evaporator was shut down. Temperature measurements were taken from the same six fixed locations throughout the season; both compartments in the back pan and all four compartments in the front pan (see Figure 1). A position in the center of each partition was chosen to represent the temperature of the entire partition. The end of the probes were placed at a height ½" from the bottom of the pan. The end of each probe was completely covered with boiling sap at all times. Temperature was measured in all 6 locations simultaneously and recorded at 30 second intervals for the entire duration of each individual boiling session.

Figure 1: 3'x 10' oil-fired, raised flue, cross-flow evaporator with partition labels.

RESULTS

The evaporator was operated on nine separate days in March to April of the 2006 season (3/15, 3/25, 3/29, 3/31, 4/3, 4/5, 4/10 and 4/12). Average daily boiling time was 3.5 hours. On March 15th the boiling point of water at Proctor Maple Research Center was measured at 210° F. The evaporator was flooded and boiled with raw sap on March 15th. The first boil lasted six and a half hours. A longer then average boiling time was needed to establish the density gradient ("sweetening the pans"). This process was done once during the season. The remaining eight days of boiling began with "sweetened pans". Pan sections were divided by plugs between boils.

The lowest average temperature in any partition was partition 1, at 208.6° F. This is the partition nearest the sap source. Partition 2 of the back pan had the next highest average temperature, 210.1° F. Partitions 3 and 4 make up the first pan of the front pan and had an average temperature of 210.9 and 212.5° F respectively. Partitions 5 and 6 make up the second and last pan of the syrup pan. The average temperatures for partitions 5 and 6 were 213.3 and 215.9° F. The standard error (SE) for each partition describes how much each partitions average temperature varied over the nine days. Small SE's were observed in partitions 1 and 2. This indicates that the average temperature in these partitions did not fluctuate greatly during the season (+/- 0.1 degrees F). Partitions 3-5 had standard errors of 0.4, 0.5 and 0.6 degrees F respectively. The largest standard error was observed in partition 6 (+/- 1.2 degrees F). Looking at the 30 second temperature measurements over time shows the fluctuations in temperature associated with the draw off and reveals some noticeable patterns.

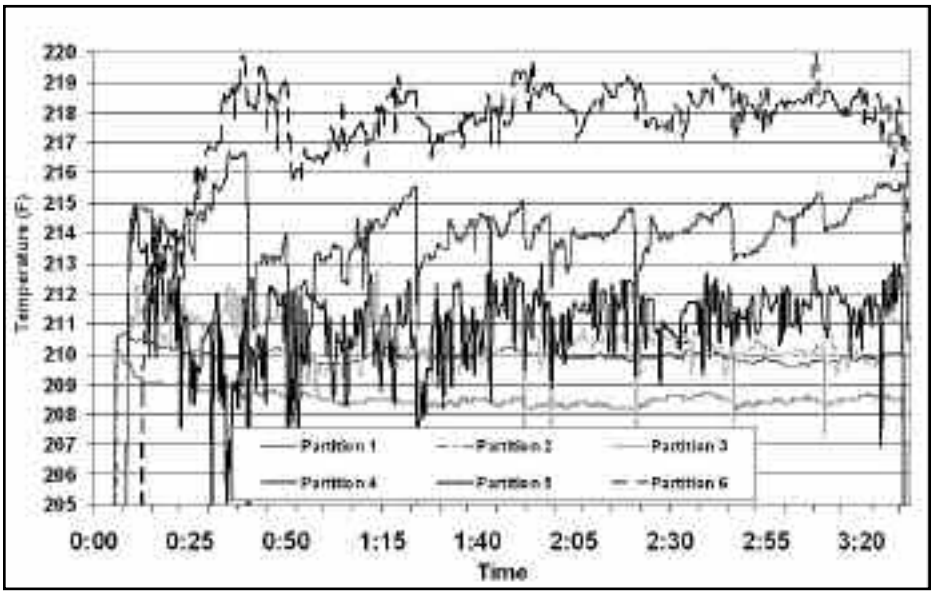

Figure 2: Partition temperatures recorded at 30 second intervals for an entire +3.5 hour boil.

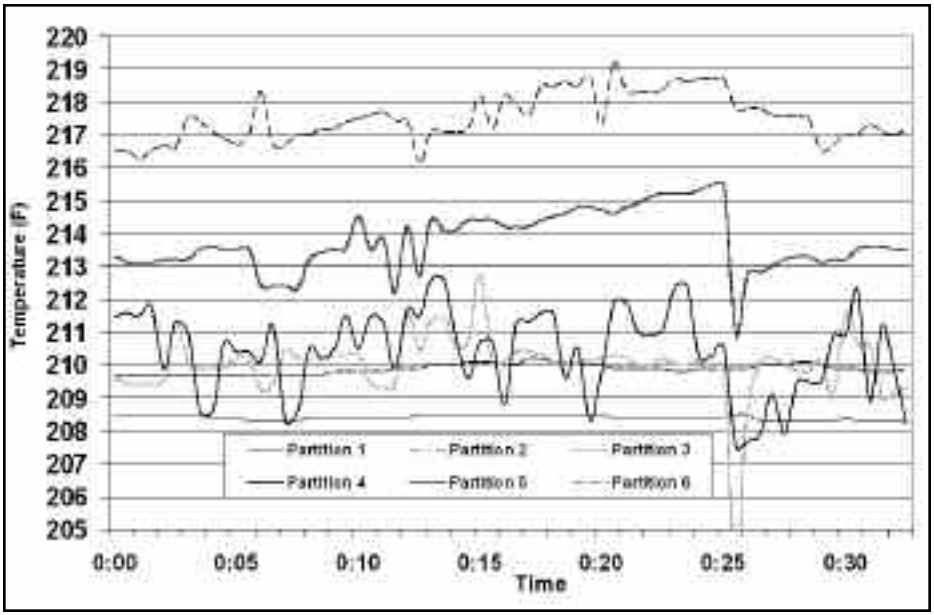

Figure 3: Partition temperatures taken from a 30 minute segment of one days boiling.

Figure 2 shows the temperatures in the front pan as a pattern of steadily rising temperatures followed by a sharp, but brief drop in temperature. The drop in temperature is brief given the large amount of heat under the pans. The time needed to bring the temperature back to the point before the draw off was around 1 minute.

The temperature fluctuations in the front pan generally range 1-2° F with an exception being the draw off event. During a draw off event the temperature in a partition will drop anywhere from 2-6° F.

Temperatures in the back pan appear relatively steady. Generally the temperature in Partitions 1 and 2 did not fluctuate more then 0.1 degrees F over the course of a days boiling. Figure 3 highlights one draw off interval. The automatic draw off opened at around minute 25.

March 15th was the first day of boiling. The average temperature in the evaporator was lower on this day then at any other time during the season. This is likely related to the process of developing the density gradient. Compared to March 15th, the remaining eight days results did not vary more then 2° F.

DISCUSSION

Temperature is commonly used to estimate the density of boiling sap in the evaporator. Therefore, knowing the temperature throughout an evaporator is a key to making a quality product.

A cycle of rising and falling temperatures was observed during the operation of a 3' x 10' evaporator which had been equipped with an automatic draw off.

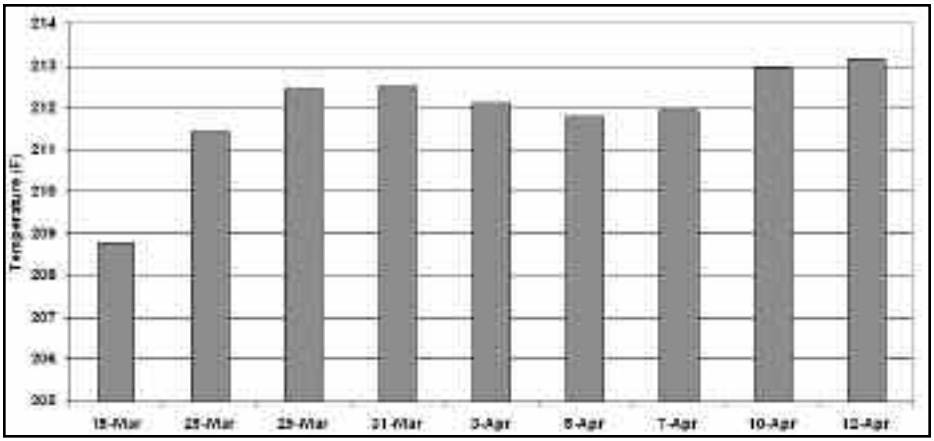

Figure 4: Average evaporator temperature in a 3' x 10' oil fired evaporator over the days of the 2006 season.

This cycle is associated with the periodic draw off of syrup in the front pan. The draw off begins when the liquid at the draw off reaches a preset temperature. As syrup exits the evaporator, the depth in the draw off partition is lowered. The lower depth is only temporary since the partially boiled syrup remaining in front pan partitions flows in to take its place. This in turn decreases the level in the float box between the front and back pans. The valve in the float box opens to accept additional sap from the back pan. When the temperature at the draw off probe falls below the preset level, the valve closes. The temperatures then immediately begin to climb. This cycle has been described as the evaporator's steady state of boiling.

The sudden opening and closing of the automatic valve may not accurately imitate the way in which a sugarmaker would choose to draw off syrup. The valve may cause unwanted mixing of partially boiled sap.

Compared to the front pan, the back pan temperature is not greatly influenced by the draw off cycle. The relatively steady temperatures in the back pan are likely a result of the comparatively large volume of liquid compared that are found in the back pan and because this is were the majority of the burners' heat is focused.

Future observations will focus how partition temperature fluctuations are different when sap concentrated with membranes is used instead of raw sap.

VACUUM SAP COLLECTION: HOW HIGH OR LOW SHOULD YOU GO?

T.R. Wilmot, T.D. Perkins and A.K. van den Berg

Proctor Maple Research Center
The University of Vermont

INTRODUCTION

Vacuum sap collection, common throughout much of the maple region, especially where medium to large modern operations are found, is not without controversy. Questions of how vacuum affects maple sap, syrup and trees have existed for many years, and these issues are perhaps more important today than ever before due to the increasing use of collection systems that can achieve very high levels of vacuum. This article will describe recent research performed at the University of Vermont Proctor Maple Research Center that was designed to answer questions about high vacuum.

The use of vacuum to augment sap collection began in some maple operations soon after the advent of plastic sap tubing in the late 50's. Early systems employed pumps designed for milking or other non-maple applications, resulting in vacuum output that was relatively low, as the pumps were not suitable for sustained operation beyond about 13-15" of mercury (Hg). As well, available tubing and fittings were difficult or impossible to make leak-free, and the vacuum level at the taphole was seldom close to the vacuum level at the pump. Despite these constraints and the difficulty of maintaining a working system, many producers with these "primitive" vacuum systems were encouraged by enhanced collection, especially during periods of slow sap flow. At the same time, researchers studying the relationship between the level of vacuum at the taphole and the amount of sap collected began to report that increasing vacuum levels apparently lead to increased sap yields[1].

Despite evidence of a positive relationship between enhanced vacuum and improved yield, until 10 to 15 years ago, equipment limitations prevented an examination of what we today would consider "high" vacuum. As late as 1989, for example, researchers stated that "the added expense and practical difficulty of attempting to maintain vacuum levels at the tap of greater than 15 in. Hg are not warranted.[2]" Today, many producers would consider collection at 15" Hg unsatisfactory. The maximum achievable vacuum at sea level is approximately 30" of mercury, which is equal to the weight of a column of air sitting over any one spot on an average day. At 2000', the air is thinner and the maximum achievable vacuum is about 28" Hg. Recent technological improvements in vacuum system design and equipment, including oil flood or liquid ring pumps, polyethylene tubing, improved fittings and spouts, and wet and dry line arrangements, have made it possible for maple producers to achieve a vacuum level close to these maximums. For many vacuum users, more is better. In a 2007 survey of Vermont sugarmakers, the average vacuum at the pump reported by 74 vacuum users

was 20.7" Hg and several producers reported keeping vacuum levels at the pump at 24-25"[3]. Producers using more than 20" Hg at the pump averaged 0.3 gallons of syrup per taphole, producers using 1"-19" at the pump averaged .22 gallons/tap, and producers who collected sap in tubing without a vacuum pump averaged .17 gal/tap.

Reports of the benefits of vacuum in terms of sap yield have long been accompanied by concerns about effects on sap and syrup quality. Morselli (1974) summarized several years of research at the Proctor Maple Research Center, which addressed some of these concerns using sap collected at what was then considered "high" vacuum (around 15" Hg at the pump)[4]. She reported that at this vacuum level there was no difference in pH, invert sugar content, phenols or mineral constituents compared to gravity collected sap, and additionally no difference in the syrup color made from gravity or vacuum sap. Possible effects of vacuum on the health of trees remained a persistent question in the minds of some producers and researchers. Studies seemed to show that at moderate vacuum levels, no abnormal cellular constituents, the presence of which might indicate rupture of living wood cells, were added to the sap; but what about at higher levels of vacuum? Additionally, an examination of wood damage (staining) associated with different levels of vacuum might also provide an indication of possible tree damage.

The experiments described below were designed to provide additional

information about sap yield, chemistry, sugar content, and tree damage at vacuum levels higher than were tested in the 1970's. While not addressing every question about the effects of high vacuum, including questions about possible effects on syrup taste, the purpose of this study was to explore some possible limitations of the usefulness of very high vacuum, as well as to illustrate possible benefits.

MATERIALS AND METHODS

The study took place in the sugarbush at the Proctor Maple Research Center, located at approximately 1400' on a west-facing slope of Mt. Mansfield in Underhill Center, VT. 30 healthy sugar maples averaging 7.5" DBH were selected for this study; small trees were used in order to facilitate dissection of the trunks for measurement of internal wounding. Trees were divided into 6 groups of 5 trees each, and each group was assigned one of 5 vacuum treatments: 15" Hg, 18", 21", 23" and 25 " while the sixth group served as a control, 0" (gravity collection). Vacuum was supplied to the trees by an oil-cooled liquid ring pump. For treatments where less than 25" Hg was needed, the vacuum from the pump was stepped down using vacuum regulators. Sap was collected in 12 liter vacuum chambers (see June 2007 Maple Digest Small Spouts page 22 for a picture of a vacuum chamber). These chambers allowed collection of sap from individual tapholes under vacuum; the sap remains in the chamber for volume measurement and sampling until it was manually emptied. Each tree was tapped once on the west side, and a new 19/64" spout and dropline were used to connect the taphole to the chamber. Control trees with gravity collection were attached to vacuum chambers which were open at the top to ambient air.

Sap volume was collected and measured from the start of the season, March 2, 2004, until April 19, 2004. Because the vacuum pump was connected to an automatic start mechanism which turned on whenever sap flowed into the main sugarhouse releaser, the tapholes were subject to vacuum for virtually all the time that the sap flowed. Sap samples were collected for analysis on four dates between March 26 and

April 13. Sap sugar content and pH were measured in the lab with a table top refractometer and pH meter, respectively. For mineral analysis, 0.5 g of each sample was analyzed for calcium, iron, magnesium, manganese, phosphorous, potassium, sodium, sulfur and zinc content by inductively coupled plasma atomic emission spectroscopy.

In order to view the staining associated with each taphole wound, all 30 test trees were cut down in July 2005 and an eight foot length of the trunk with the taphole in the center was brought to the lab. Each trunk section was sawn lengthwise into a 3" wide strip for ease of handling by a sawyer using a portable mill. This strip was then cut horizontally into pieces using a miter saw, starting at the taphole and moving above and below the taphole in 2" increments until the stain was no longer visible (Figure 1). The volume of stained wood associated with each taphole was calculated based on the visible length, width, and depth of each stain.

Figure1. Sections cut from a maple trunk 15 months after vacuum sap collection. The top section contains the taphole; sections below were cut at 2" intervals and show the diminishing size of the stain with distance from the wound.

RESULTS AND DISCUSSION

Total sap volume per taphole ranged from 5.0 gallons (one of the gravity trees) to 32.9 gallons (one of the trees at 25" Hg). When the 5 trees per treatment were averaged together, there was a strong correlation between the amount of vacuum and the amount of sap collected (Figure 2). These results parallel those of previous researchers.

Sap sugar content is notoriously variable; among the 30 test trees it varied (average of 4 dates) from 2.475% for the sweetest tree to 1.1% for the least sweet. There was no significant trend in the relationship between sap sugar content and vacuum level (Figure 3); in other words, sap was not diluted at higher vacuum levels. It is interesting to note that had this experiment been limited to 21" Hg, which was about the achievable limit at the taphole using technology available before the mid-late 1990's, there would have been an apparent dilution effect as more vacuum was

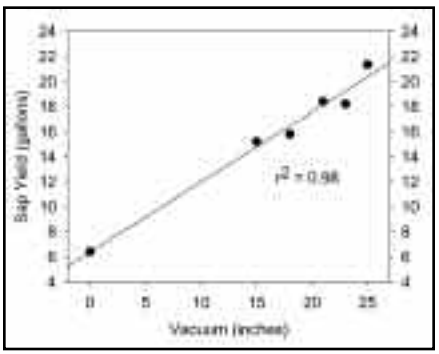

Figure 2. Relationship between vacuum and sap yield. Each circle represents the average of 5 trees.

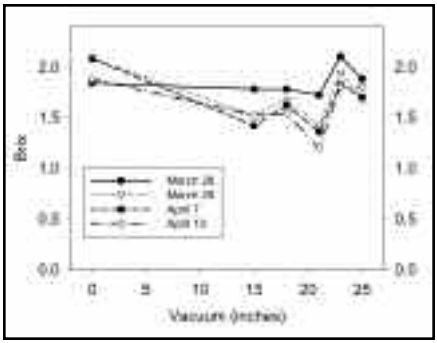

Figure 3. Relationship between vacuum and sap sugar concentration, measured on 4 separate dates during the sap season.

applied; however results from 23" and 25" Hg defy this interpretation.

The range of pH from individual sap samples was 5.63 to 8.45, with sap becoming more acid as the season progressed. Average sap pH from all trees dropped from 7.37 on March 26 to 6.42 on April 13; however there were no differences among vacuum levels for pH. Mineral composition of the sap showed no particular trends related to vacuum level (Figure 4). While there was some variability in sap composition among different vacuum levels compared to control sap, there was no indication that increasing vacuum was augmenting or depleting sap nutrients.

Wounds in maple stems , including tapholes, have an associated stain (discolored area) caused by the natural wound response of the tree to invasion of fungi into the wood, These stains can be useful for determining the amount of sap wood in the trunk that is permanently compartmentalized by the tree, i.e. no longer used for sap transport. Tree damage, evaluated as the total volume of the stained wood associated with a taphole, ranged from 25 cm^3 to 137 cm^3 (for reference, the volume of one foot of 1" mainline is 61 cm3). The average volume of stained wood for each treatment fell within a fairly narrow range. Trees subjected to 18" Hg had the smallest amount of stained wood (less than the gravity trees), and trees subjected to 23" Hg had greatest amount (Figure 5), but trees subjected to 25" Hg had the second smallest amount of stained wood. None of these differences were statistically significant, thus vacuum level had no effect on the amount of visible internal damage to these trees.

This study dealt with many, but not

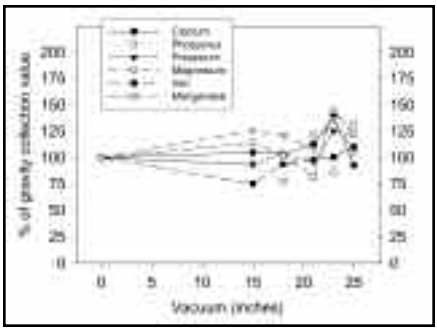

Figure 4. Changes in mineral concentration of the sap with increasing vacuum. Concentration of each mineral is compared to the concentration in gravity collected sap.

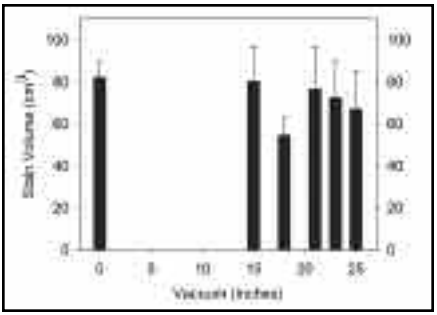

Figure 5. Relationship between vacuum level and the volume of stained wood associated with the taphole wound. Each bar represents the average of 5 trees.

all issues surrounding the use of high vacuum sap collection. A persistent question involves the amount of sugar taken from the tree — since vacuum collection permits greater yields from tapholes, would it be possible to remove too much of the tree's carbohydrate reserves? To date, no published study has quantified the total amount of stored sugar in mature maples, due in large part to the difficulty of accurately measuring the huge amount of biomass that must be cut down and excavated, digested, and sampled. Estimates of the amount of a tree's reserves removed from sugaring range from less than 1% to upwards of 10%. Sugarmakers should be reassured however that no studies have documented maple dieback or decline resulting from the use of vacuum for sap collection. Another issue relates to syrup quality. While some producers persist in believing that vacuum collected sap results in syrup that tastes different, many prize winning syrups have come from sap collected under high vacuum. There is certainly room for more research around both of these subjects, as more and more producers discover the benefits of vacuum in their sugaring operations.

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[1]Walters, R.S. and H.C. Smith. 1971. Sugar maple sap volume increases as vacuum level is increased. USDA For. Serv. Res. Note NE-213. 4pp.

[2]Kelley, J. W. and L.J. Staats. 1989. High-vacuum pumping effects on maple sap sugar yield. North. J. Appl. For. 6:126-129.

[3]Wilmot, T. R. 2007. Tapping Survey Results. Electronic Publication.

[4]Morselli, M.F. 1974. Effect of high vacuum pumps on volume yield and composition of maple sap. IN La production du Sirop d'Erable. Compte Rendu du 3e Coloque de Genie Rural, Laval Univ., Quebec. 65-71.

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2007-2008 New York Calendar of Upcoming Schools and Workshops

October 6 — Confections Workshop I, Lewis County, NY. **Contact:** Michele Ledoux, Cornell Cooperative Extension Lewis County, 5274 Outer Stowe Street, P.O. Box 72, Lowville, New York 13367, Phone: 315-376-5270.

October 12 — Maple Confections Workshop I, Central NY, Arnot Forest. **Contact:** Stephen Childs, 110 Fernow Hall, Cornell University, Ithaca, NY 14853, 607-255-1658, fax 607-255-2815, slc18@cornell.edu

October 13 — Maple Confections Workshop II, Central NY, Arnot Forest. **Contact:** Stephen Childs, 110 Fernow Hall, Cornell University, Ithaca, NY 14853, 607-255-1658, fax 607-255-2815, slc18@cornell.edu

October 16 — Confections Workshop II, Wyoming County, NY. **Contact:** Lutie Batt, Cornell Cooperative Extension of Wyoming County, 401 North Main Street, Warsaw NY 14569, Phone: 585-786-2251.

October 26-27 — Confections Workshop II, Wyoming County, NY. **Contact:** Lutie Batt, Cornell Cooperative Extension of Wyoming County, 401 North Main Street, Warsaw NY 14569, Phone: 585-786-2251.

October 31 — November 1 Confections Workshop I, Franklin County, NY. **Contact:** Richard Gast, Education Center, Court House, 355 West Main Street, Suite 150, Malone, NY 12953, Phone: (518) 483-7403, Fax: (518) 483-6214, Email: rlg24@cornell.edu

November 2-3 — Confections Workshop II, Lewis County, NY. **Contact:** Michele Ledoux , Cornell Cooperative Extension Lewis County, 5274 Outer Stowe Street, P.O. Box 72, Lowville, New York 13367, Phone: 315-376-5270.

January 4-5 — New York State Maple Conference, Verona NY, **Contact:** Keith Schiebel kschiebel@vvsschools.org

January 12, 2008 — Lewis County Maple School **Contact:** Michele Ledoux, Cornell Cooperative Extension Lewis County, 5274 Outer Stowe Street, P.O. Box 72, Lowville, New York 13367, Phone: 315-376-5270.

January 19, 2008 — Western NY Maple School, **Contact:** Lutie Batt, Cornell Cooperative Extension of Wyoming County, 401 North Main Street, Warsaw NY 14569, Phone: 585-786-2251.

January 26, 2008 — Maple Expo — St. Lawrence County, Potsdam Central School, **Contact:** Steve VanderMark, 1894 State Highway 68, Canton, NY 13617-1477, sfv1@cornell.edu, Phone: 315-379-9192.

February 2, 2008 — Warren Washington County Maple School, **Contact:** Contact: Laurel R. Gailor, Natural Resource Educator, lrg6@cornell.edu, Cornell Cooperative Extension, Warren County, 377 Schroon River Road, Warrensburg, NY 12885, Phone: 518-623-3291, 518-668-4881.

February 9, 2008 — Schoharie County Maple School, Contact: JJ Schell, jjs69@cornell.edu, Cornell Cooperative Extension of Schoharie County, 173 South Grand Street, Cobleskill NY 12839, Phone: 518-234-4303.

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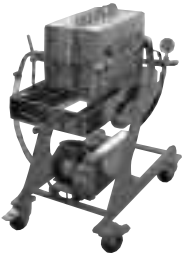

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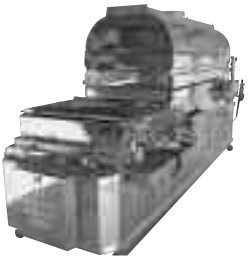

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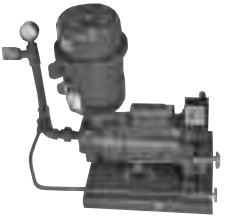

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NEW YORK STATE MAPLE PRODUCERS CONFERENCE
January 4 and 5, 2007
Vernon-Verona-Sherrill High School, Verona, NY
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